

***TEST WELLS TW1, TW2, AND TW3,  
WHITE SANDS MISSILE RANGE,  
OTERO COUNTY, NEW MEXICO***

By Robert G. Myers and Karen M. Pinckley

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DEPARTMENT OF THE INTERIOR  
DONALD PAUL HODEL, Secretary  
U.S. GEOLOGICAL SURVEY  
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### CONVERSION FACTORS

In this report, measurements are given in inch-pound units only. The following table contains factors for converting to metric units:

<u>Multiply inch-pound units</u>	<u>By</u>	<u>To obtain metric units</u>
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
cubic inch	16.4	cubic centimeter

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

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**ABSTRACT**

Three test wells, TW1, TW2, and TW3, were drilled at White Sands Missile Range in south-central New Mexico in July, August, and October 1983 as part of a joint military training program sponsored by the U.S. Navy and U.S. Army in July, August, and October 1983. The test wells were drilled as exploratory and monitoring wells for the toxic-waste storage facility at White Sands Missile Range. Information obtained from these wells includes lithologic logs for all wells and borehole-geophysical logs for the cased wells.

**INTRODUCTION**

Three test wells, TW1, TW2, and TW3 (fig. 1; table 1), were drilled at White Sands Missile Range in south-central New Mexico in July, August, and October 1983 as part of a joint military training program sponsored by the U.S. Navy and U.S. Army in July, August, and October 1983. The U.S. Geological Survey assisted White Sands Missile Range personnel in site selection, borehole-geophysical logging, analysis of well cuttings, and compilation of lithologic logs. To date (October 1986), none of these wells have been developed nor have water samples been available for chemical analyses. Driller's logs are not available. This study was done in cooperation with the Department of the Army, White Sands Missile Range, Facilities Engineering Directorate.

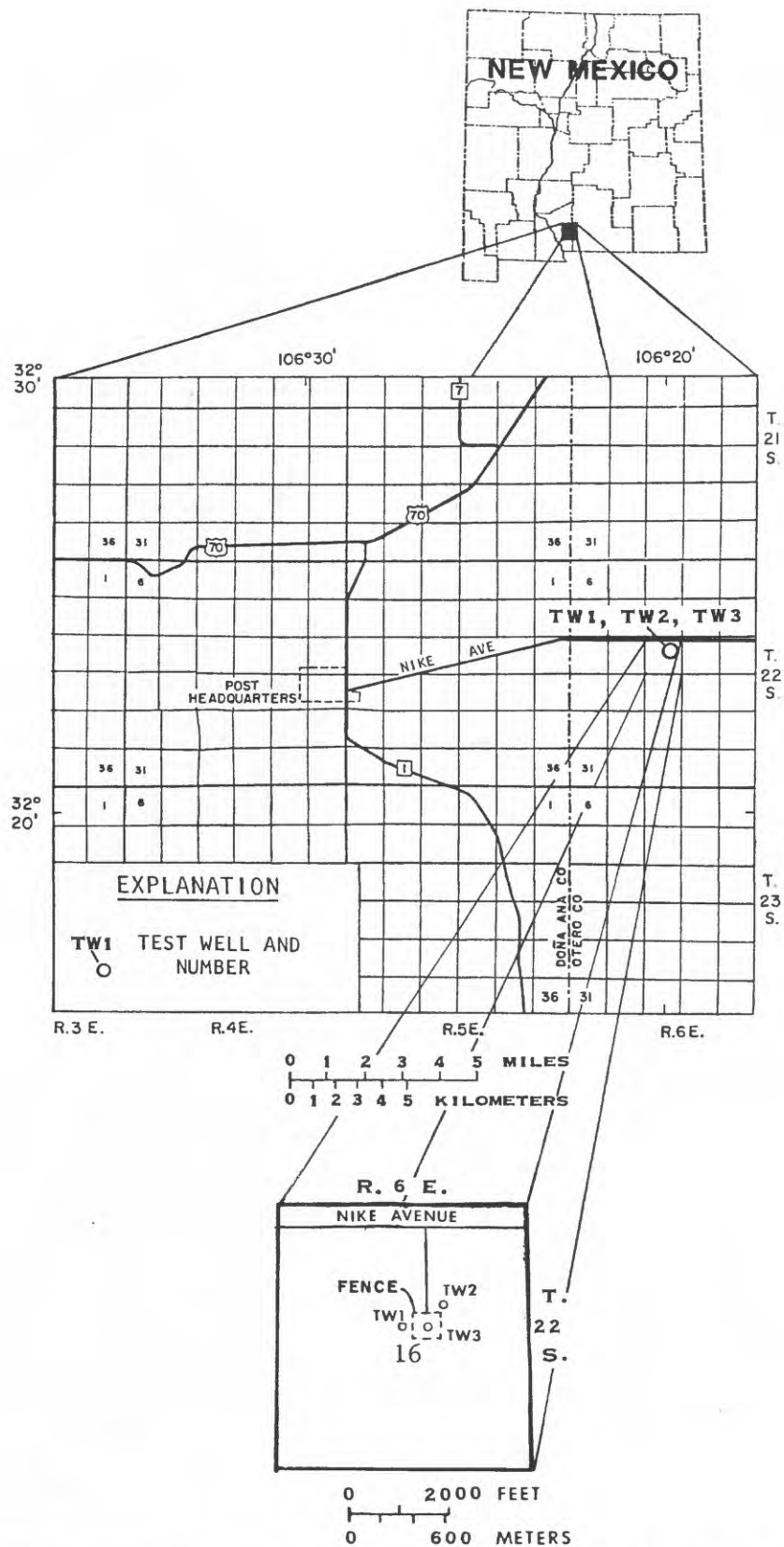


Figure 1.--Location of test wells TW1, TW2, and TW3, White Sands Missile Range.

**Table 1. Well records of test wells TW1, TW2, and TW3, White Sands  
Missile Range**

Well name	Location	Date drilled	Hole diameter (inches)	Drilled depth (feet)	Finished depth (feet)	Screen interval (depth below land surface) (feet)	Casing diameter (inches-type)
TW1	22S.06E.16.233	7-83	9 7/8	300	285	225-285	4 (PVC)
TW2	22S.06E.16.234	8-83	9 7/8	300	285	225-285	4 (PVC)
TW3	22S.06E.16.234A	10-83	9 7/8	300	290	230-270	4 (PVC)

Well name	Altitude of land surface (feet)	Water level below land surface (feet)	Date measured
TW1	4,031.81	229.00 228.96	9-8-83 10-13-86
TW2	4,038.22	235.46 235.80	9-8-83 10-13-86
TW3	4,037.19	232.42 234.57	7-26-84 10-13-86

Lithologic logs in this report were prepared by the U.S. Geological Survey from cutting samples collected by U.S. Navy and U.S. Army personnel. The following list defines the terms used to describe the grain size of the detritus:

Description	Size in millimeters	Size in inches
Pebbles	4-64	0.16-2.5
Granules	2-4	0.08-0.16
Very coarse sand	1.0-2.0	0.04-0.08
Coarse sand	0.5-1.0	0.02-0.04
Medium sand	0.25-0.5	0.01-0.02
Fine sand	0.125-0.25	0.005-0.01
Very fine sand	0.0625-0.125	0.0025-0.005
Silt	0.004-0.0625	0.00015-0.0025
Clay	less than 0.004	less than 0.00015

The degrees of grain rounding were determined from comparison with the grain models in the Manual of Field Geology (Compton, 1962). The degree of roundness can range from very angular to well rounded. Sorting is the degree to which grains in a sample approach the same size. The degree can range from very well sorted (grains all the same size) to very poorly sorted (a wide range of grain sizes with no dominant grain sizes). Colors and any accompanying code numbers in the lithologic descriptions refer to colors from the Rock-Color Chart (Goddard, 1948) prepared by the Rock-Color Chart Committee and distributed by the Geological Society of America.

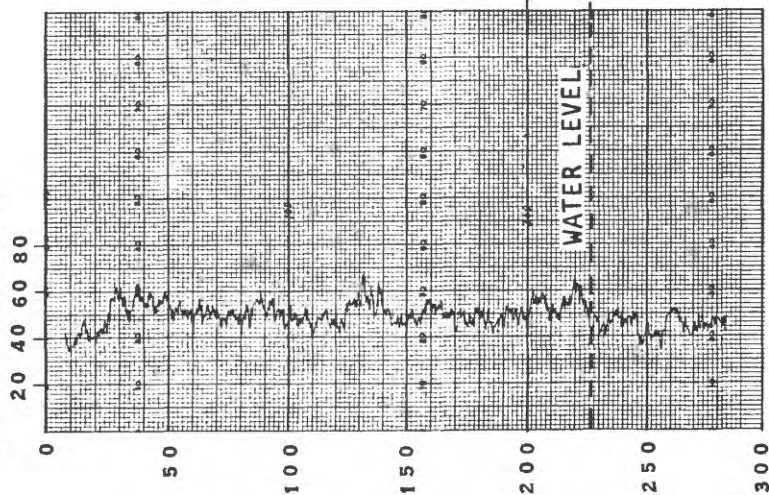
### TEST WELLS TW1, TW2, and TW3

Test wells TW1, TW2, and TW3 (fig. 1) were drilled as exploratory and monitoring wells in the vicinity of the toxic-waste storage facility at White Sands Missile Range. The hydraulic-rotary drilling method was used to drill the test wells. Test well water-level and construction data are presented in table 1. The main purposes of wells at this locality are to obtain hydrogeologic data and to use the completed wells for monitoring water levels and water quality. Test wells TW1 and TW2 were drilled with a bentonite drilling fluid and test well TW3 was drilled with an organic-polymer drilling fluid. Natural gamma, neutron, and gamma-gamma borehole-geophysical logs made in the cased test wells TW1, TW2, and TW3 are shown in figures 2, 3, and 4, respectively. The wells penetrate interbedded clay, silt, sand, and some gravel in the Quaternary alluvium and bolson fill of the Tularosa Basin. Lithologic logs prepared by the U.S. Geological Survey (fig. 5) from analyses of well cuttings collected from test wells TW1, TW2, and TW3 by the U.S. Navy and U.S. Army are shown in tables 2, 3, and 4, respectively.



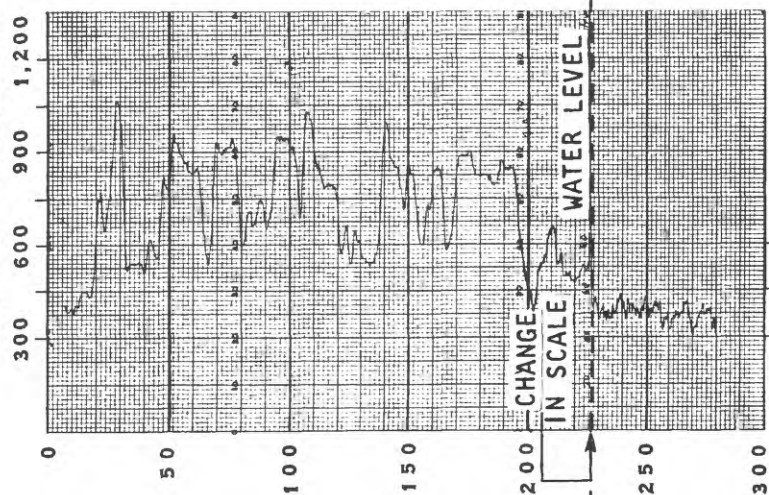
# NATURAL GAMMA

COUNTS PER SECOND



# NEUTRON

COUNTS PER SECOND



# GAMMA-GAMMA

COUNTS PER SECOND

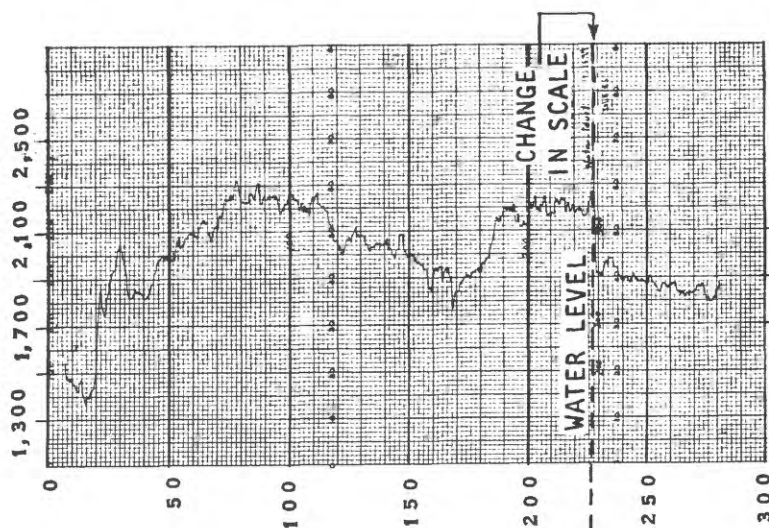
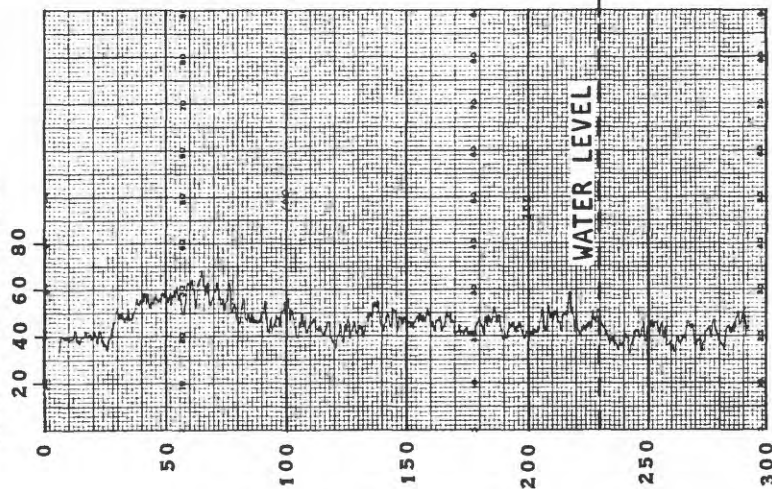


Figure 2.--Natural gamma, neutron, and gamma-gamma logs for test well TW1

(22S.06E.16.233) with casing.

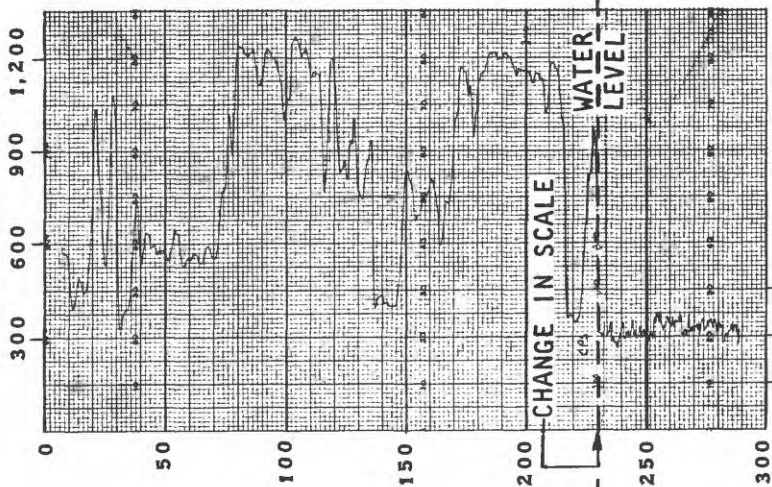
# NATURAL GAMMA

COUNTS PER SECOND



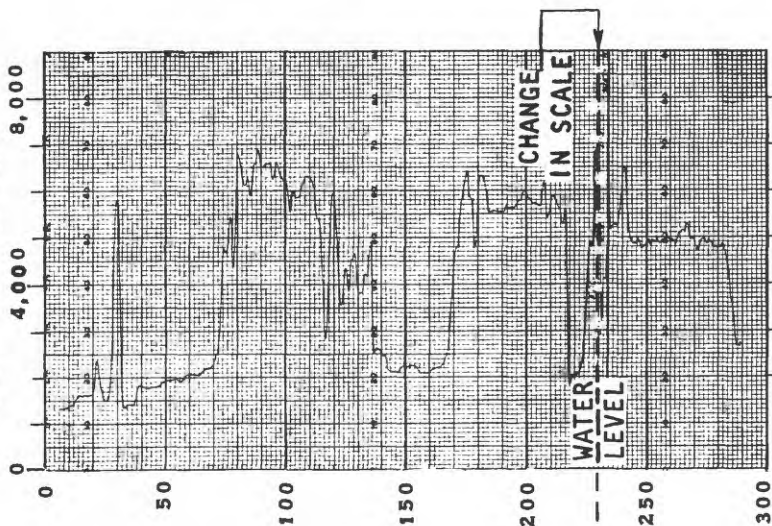
# NEUTRON

COUNTS PER SECOND



# GAMMA - GAMMA

COUNTS PER SECOND



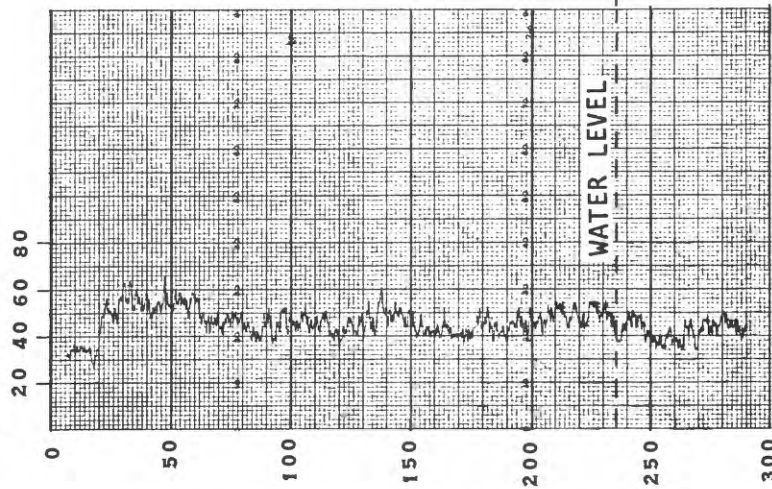
COUNTS PER SECOND

COUNTS PER SECOND

Figure 3.--Natural gamma, neutron, and gamma-gamma logs for test well TW2 (22S.06E.16.234) with casing.

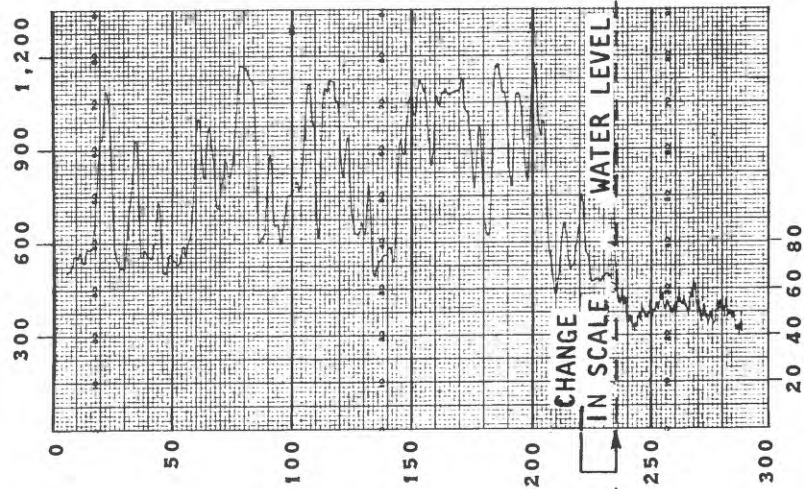
# NATURAL GAMMA

COUNTS PER SECOND



# NEUTRON

COUNTS PER SECOND



# GAMMA-GAMMA

COUNTS PER SECOND

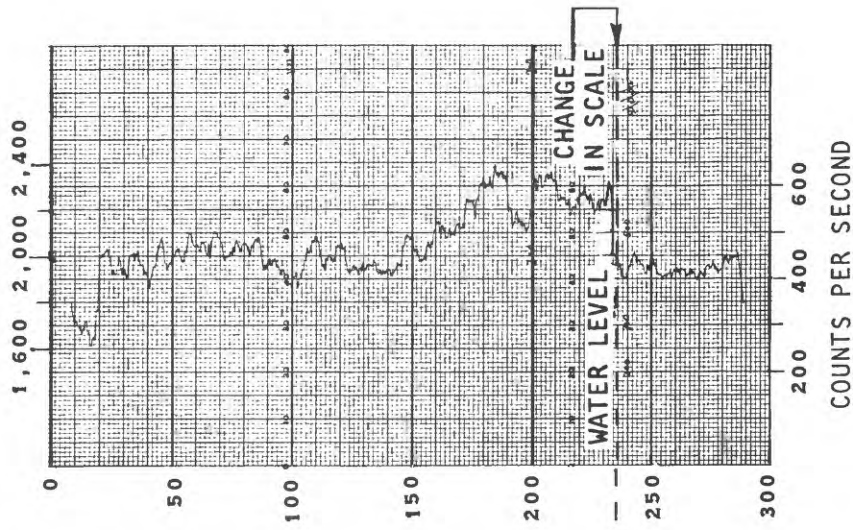
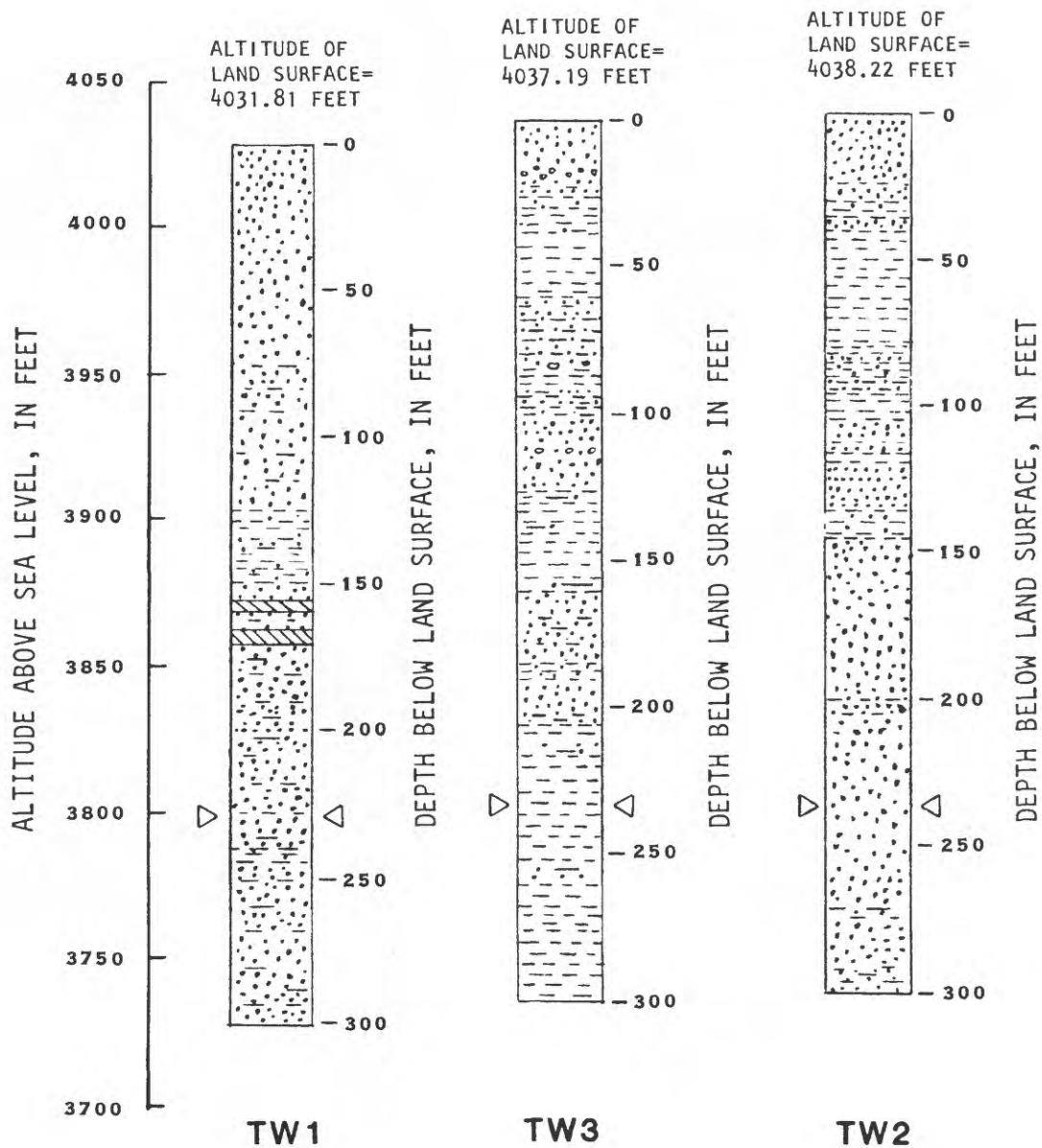


Figure 4.--Natural gamma, neutron, and gamma-gamma logs for test well TW3  
(22S.06E.16.234A) with casing.



#### EXPLANATION

	GRAVEL		CLAY
	SAND		NO SAMPLE
	SILT		STATIC WATER LEVEL

Figure 5.--Lithologic logs of test wells TW1, TW2, and TW3.

**Table 2. Lithologic log for test well TW1 (22S.06E.16.233)**

[Some samples were washed]

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Sand, fine- to medium-grained; subrounded to well rounded, moderately well sorted; composed of quartz with a small amount of chert and dark (igneous and sedimentary) rock; abundant moderate-reddish-orange (10R 6/6) caliche; interval contains a greater amount of fine-grained sand, less caliche, and becomes well sorted with increasing depth.	10	0-10
Sand, fine- to coarse-grained; subrounded to well rounded, moderately sorted; composed of quartz with a very small amount of dark (igneous and sedimentary) rock; caliche present.	5	10-15
Sand, fine- to medium-grained; subrounded to well rounded, moderately to well sorted; composed of quartz with a very small amount of chert and dark (igneous and sedimentary) rock; some moderate-brown (5YR 4/4) clay occurs from 75 to 125 feet; caliche present throughout.	110	15-125
Clay, moderate-yellowish-brown (10YR 5/4), and fine- to medium-grained sand; subrounded, well sorted; sand composed of quartz and very small amounts of chert, feldspar, and dark (igneous and sedimentary) rock; less clay present from 135 to 140 feet; sand mostly fine grained from 140 to 145 feet; a small amount of soft, clayey caliche throughout interval.	25	125-150
Sand, fine- to medium-grained; subangular to subrounded, well sorted; composed of quartz with small amounts of dark rock and chert; pieces of moderate-reddish-orange (10R 6/6) caliche and some silt.	5	150-155



**Table 2. Lithologic log for test well TW1 (22S.06E.16.233) - Continued**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
NO SAMPLE	5	155-160
Sand, fine- to medium-grained, and some moderate-brown (5YR 4/4) clay; moderately well sorted; sand is subangular to subrounded; composed of quartz and dark rock; caliche present.	5	160-165
NO SAMPLE	5	165-170
Sand, fine- to medium-grained, and some moderate-brown (5YR 4/4) clay; moderately well sorted; sand subangular to subrounded and composed of quartz with very small amounts of dark (igneous and sedimentary) rock; abundant caliche.	30	170-200
Silt to fine-grained sand; subangular, moderately well sorted; composed of quartz with small amounts of dark (igneous and sedimentary) rock and feldspar; abundant caliche.	5	200-205
Sand, fine- to medium-grained, and some moderate-brown (5YR 4/4) clay; moderately well sorted; sand subangular to subrounded and mainly composed of quartz; very little clay present from 225 to 230 feet; most sand fine grained from 235 to 240 feet; caliche throughout.	35	205-240

**Table 2. Lithologic log for test well TW1 (22S.06E.16.233) - Concluded**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Clay, moderate-brown (5YR 4/4), some fine- to medium-grained sand, and pieces of moderate-reddish-orange (10R 6/6) caliche; moderately sorted; sand subangular to subrounded and composed of quartz with a small amount of dark (igneous and sedimentary) rock.	5	240-245
Sand, fine- to medium-grained, and some moderate-brown (5YR 4/4) clay; moderately to well sorted; sand subangular to subrounded and composed of quartz with very small amounts of dark rock and feldspar.	55	245-300

**Table 3. Lithologic log for test well TW2 (22S.06E.16.234)**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Sand, medium-grained, and caliche; moderately sorted; sand subrounded to well rounded; composed of quartz, chert, and feldspar.	5	0-5
Sand, medium- to coarse-grained; subrounded to well rounded, well sorted; composed of quartz and small amounts of chert, feldspar, and granite; some caliche from 10 to 15 feet; less coarse-grained sand from 15 to 20 feet; some moderate-reddish-orange (10R 6/6) caliche throughout.	15	5-20
Sand, medium- to coarse-grained, and hard pieces of moderate-brown (5YR 4/4) clay; moderately well sorted; sand subrounded to well rounded; composed of quartz with small amounts of chert, feldspar, and granite; some fine-grained sand from 25 to 30 feet.	10	20-30
Clay, moderate-yellowish-brown (10YR 5/4), and some fine- to medium-grained sand; sand subrounded and mostly composed of quartz; clay contains moderate-reddish-orange (10R 6/6) caliche.	5	30-35
Sand, fine- to medium-grained; subrounded, well sorted; predominately composed of quartz; caliche abundant and ranges in color from white to yellowish grey (5Y 8/1) to moderate reddish orange (10R 6/6), and contains fine- to medium-grained sand.	5	35-40
Clay, moderate-yellowish-brown (10YR 5/4); well sorted; some caliche.	40	40-80
Sand, medium- to coarse-grained, caliche, and moderate-yellowish-brown (10YR 5/4) clay; moderately sorted; sand subrounded and composed of quartz with a small amount of chert.	5	80-85



**Table 3. Lithologic log for test well TW2 (22S.06E.16.234) - Continued**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Clay, pale-yellowish-brown (10YR 6/2), and very small amounts of fine-grained sand and pieces of caliche; well sorted.	5	85-90
Silt, moderate-yellowish-brown (10YR 5/4), and some very fine grained quartz sand; very well sorted.	5	90-95
Clay, moderate-yellowish-brown (10YR 5/4); very well sorted; hard pieces of caliche present from 100 to 105 feet.	10	95-105
Sand, fine- to medium-grained; subrounded to rounded, well sorted; composed of quartz with a little chert, feldspar, and dark rock; abundant caliche cement.	5	105-110
Sand, medium-grained, and some moderate-yellowish-brown (10YR 5/4) clay and hard pieces of caliche; moderately well sorted; sand subangular to subrounded and composed of quartz with some chert.	5	110-115
Clay, moderate-yellowish-brown (10YR 5/4), and hard pieces of caliche; moderately well sorted.	5	115-120
Sand, fine- to coarse-grained; subrounded to rounded, moderately well sorted; composed of quartz with some chert and feldspar; abundant caliche.	5	120-125
Sand, medium-grained; subrounded to rounded, very well sorted; composed of quartz and chert; abundant caliche cement on grains.	10	125-135

**Table 3. Lithologic log for test well TW2 (22S.06E.16.234) - Concluded**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Clay, moderate-yellowish-brown (10YR 5/4), and small amounts of fine- to medium- grained sand and caliche; sand content increases with depth.	10	135-145
Sand, medium-grained; subrounded to well rounded, well to very well sorted; composed of quartz with a small amount of chert and a dark-colored rock; interval contains moderate-reddish- orange (10R 6/6) and moderate-orange- pink (5YR 8/4) caliche; some fine-grained sand and silt occur from 205 to 210 feet; from 265 to 270 feet, most sand fine to medium grained; some moderate-yellowish- brown (10YR 5/4) clay present from 270 to 275 feet and from 290 to 300 feet.	155	145-300

**Table 4. Lithologic log for test well TW3 (22S.06E.16.234A)**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Caliche and very fine to medium-grained sand; moderately well sorted; sand angular to subrounded and composed of quartz with some granite, feldspar, igneous rock, and a small amount of biotite; some fine and clayey caliche.	5	0-5
Caliche and very fine to coarse-grained sand; moderately well sorted; sand angular to subrounded and composed of quartz with some granite, feldspar, igneous rock, and biotite; slightly less caliche than previous interval.	10	5-15
Pebbles up to 10 millimeters; subangular to rounded, poorly sorted; composed of caliche-cemented sandstone, quartz, and granite.	5	15-20
Sand, very fine to coarse-grained, caliche, and a very small amount of moderate-yellowish-brown (10YR 5/4) clay; moderately sorted; sand angular to subrounded and composed of quartz with some igneous rock and feldspar; caliche present as moderate-reddish-orange (10R 6/6) pieces and as white grain cement.	5	20-25
Clay, silty, moderate-yellowish-brown (10YR 5/4), and some very fine grained sand; well sorted; sand subangular to subrounded and mostly composed of quartz; abundant caliche.	5	25-30
Clay, moderate-yellowish-brown (10YR 5/4); very well sorted; interval from 35 to 40 feet is silty; caliche present throughout.	30	30-60

**Table 4. Lithologic log for test well TW3 (22S.06E.16.234A) - Continued**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Sand, very fine to very coarse grained, and a very small amount of hard, moderate-brown (5YR 3/4) clay; poorly sorted; sand subangular to subrounded and composed of quartz with some igneous rock, feldspar, granite, and metamorphic rock; caliche present as grain cement and as hard, white pieces.	5	60-65
Silt, moderate-yellowish-brown (10YR 5/4), and some very fine to fine-grained sand; well sorted; sand subangular to subrounded and predominately composed of quartz; a small amount of moderate-yellowish-brown (10YR 5/4) clay present from 70 to 75 feet; some of the sand from 75 to 80 feet is medium to coarse grained; abundant caliche cement throughout.	15	65-80
Caliche, moderate-orange-pink (5YR 7/4) clay, and very fine grained sand to granules; poorly sorted; grains angular to sub-rounded and composed of quartz, caliche-cemented sandstone, and some igneous and metamorphic rock.	5	80-85
Clay, silty, moderate-yellowish-brown (10YR 5/4), and some very fine to fine-grained sand; very well sorted; sand predominately subrounded and composed of quartz; contains caliche cement.	15	85-100
Sand, very fine to fine-grained; angular to subrounded, very well sorted; composed of quartz with some igneous and metamorphic rocks, feldspar, hornblende, and biotite; contains caliche cement and some silt.	10	100-110

**Table 4. Lithologic log for test well TW3 (22S.06E.16.234A) - Continued**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Sand, coarse- to very coarse grained, and some very fine to fine-grained sand and granules to pebbles up to 6 millimeters; poorly sorted; grains angular to rounded and composed of quartz, with some caliche-cemented sandstone, igneous rock, and feldspar; abundant caliche cement.	5	110-115
Sand, very fine to medium-grained; subangular to subrounded, moderately well sorted; composed of quartz with some caliche-cemented sandstone and igneous rock; some moderate-yellowish-brown (10YR 5/4); abundant caliche.	5	115-120
Sand, very fine to medium-grained, and some coarse-grained sand; subrounded with some angular to subangular, well sorted; composed of quartz with small amounts of feldspar, granite, and caliche-cemented sandstone.	5	120-125
Clay, moderate-yellowish-brown (10YR 5/4), very well sorted; some silt from 125 to 130, 135 to 140, and 155 to 160 feet; caliche throughout.	35	125-160
Sand, very fine to medium-grained; angular to subrounded, well sorted; composed of quartz with small amounts of igneous rock and feldspar; caliche cement.	5	160-165
Sand, very fine to medium-grained, and some moderate-yellowish-brown (10YR 5/4) clay and silt; well sorted; sand angular to subrounded and composed of quartz with some feldspar and igneous rock; caliche cement throughout.	20	165-185

**Table 4. Lithologic log for test well TW3 (22S.06E.16.234A) - Concluded**

Lithology	Thickness (feet)	Depth interval below land surface (feet)
Clay, moderate-yellowish-brown (10YR 5/4), and some very fine to fine-grained sand; well sorted; sand predominately subrounded quartz; some caliche.	5	185-190
Sand, very fine to medium-grained; angular to subrounded, well sorted; composed of quartz with small amounts of feldspar, igneous rock, and granite; some moderate- yellowish-brown (10YR 5/4) silty clay from 200 to 205 feet; caliche cement throughout.	15	190-205
Clay, moderate-yellowish-brown (10YR 5/4); very well sorted; small amounts of silt to medium-grained, subangular, quartz sand present from 210 to 215 and 255 to 260 feet; caliche throughout.	95	205-300

## REFERENCES

- Compton, R.R., 1962, Manual of field geology: New York, John Wiley and Sons, Inc., 378 p.
- Goddard, E.N., chm., and others, 1948, Rock-Color Chart: Washington, D.C., National Research Council (reprinted by Geological Society of America, 1951, 1963, 1970, 1975, 1979, 1980).